S800 I/O

Modules and Termination Units
with Intrinsic Safety Interface

User’s Guide

3BSE 020 927R101

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TABLE OF CONTENTS

Chapter 1 - Introduction

1.1 About This Book 2
1.2 Product Overview 3
    1.2.1 Product Scope 3
        1.2.1.1 Module Termination Units 3
        1.2.1.2 I/O Modules 6
1.3 Prerequisites and Requirements 7
1.4 Related Documentation 7
1.5 Terminology 8

Chapter 2 - Installation

2.1 Hazardous Area Interfacing 11
2.2 General description of an I.S. system 11
2.3 System design considerations 12
2.4 Wiring of intrinsically safe circuits 13
2.5 Grounding information 14
2.6 Mounting equipment in Zone2 hazardous areas 14

Chapter 3 - Configuration

3.1 Before You Start 15
    3.1.1 Module Termination Units (MTU) 15
    3.1.2 I/O Modules 16

Chapter 4 - Operation

Chapter 5 - Maintenance

5.1 Preventive Maintenance 19
5.2 Hardware Indicators 19
    5.2.1 I/O Module LEDs 19
5.3 Error Messages 21
5.4 Fault Finding and User Repair 22
    5.4.1 I/O Module Replacement 22

CONTENTS (continued)

Appendix A - References

A.1 AI890 Analog Input Module, 0...20 mA 25
A.2 AO890 Analog Output Module, 0...20 mA 31
A.3 DI890 Digital Input Module, switch/prox. 37
A.4 DO890 Digital Output Module 42
A.5 TU890 Intrinsic Safety Compact MTU 49

ILLUSTRATIONS

Figure 1-1. S800 I/O Fieldbus Communication Interface with an I/O Module on Compact and Extended MTUs 1
Figure 1-2. Typical Compact MTU without and with I/O Module 5
Figure 5-1. Examples of I/O Module LED Locations 21
Figure A-1. Output characteristics for DO 890 46
Figure A-2. Connections 52

TABLES

Table 1-1. Related documents 7
Table 3-1. MTU Usage and Key Settings 15
Table 5-1. Standard LEDs on I/O Modules 20
Table 5-2. I/O Module LED Indications in Different States 20
Table 5-3. Replacement Aspects of S800 I/O Modules 23
Table A-1. AI890 Analog Input Module Specifications at 25×C 26
Table A-2. AI890 Analog Input Module Intrinsic Safety Parameters 28
Table A-3. AI890 Process Connections 30
Table A-4. AO890 Analog Output Module Specifications at 25×C 32
Table A-5. AO890 Analog Input Module Intrinsic Safety Parameters 34
Table A-6. A0890 Process Connections 36
Table A-7. DI890 Digital Input Module Specifications 38

TABLES (continued)

Table A-8. DI890 Analog Input Module Intrinsic Safety Parameters 40
Table A-9. DI890 Process Connections 41
Table A-10. DO890 Digital Output Module Specifications 43
Table A-11. DO890 Analog Input Module Intrinsic Safety Parameters.......................45
Table A-12. DO890 Process Connections 48
Table A-13. TU890 Compact MTU Specifications..50

Chapter 1 Introduction

The S800 I/O is distributed modular I/O which communicates with numerous controllers over a Advant Fieldbus 100 (AF 100), PROFIBUS-DP or directly.

The S800 I/O provides easy installation of the I/O modules and process cabling. It is highly modularized and flexible so that I/O modules can be combined to suit many applications.The S800 I/O can be mounted in many configurations to fit most requirements.

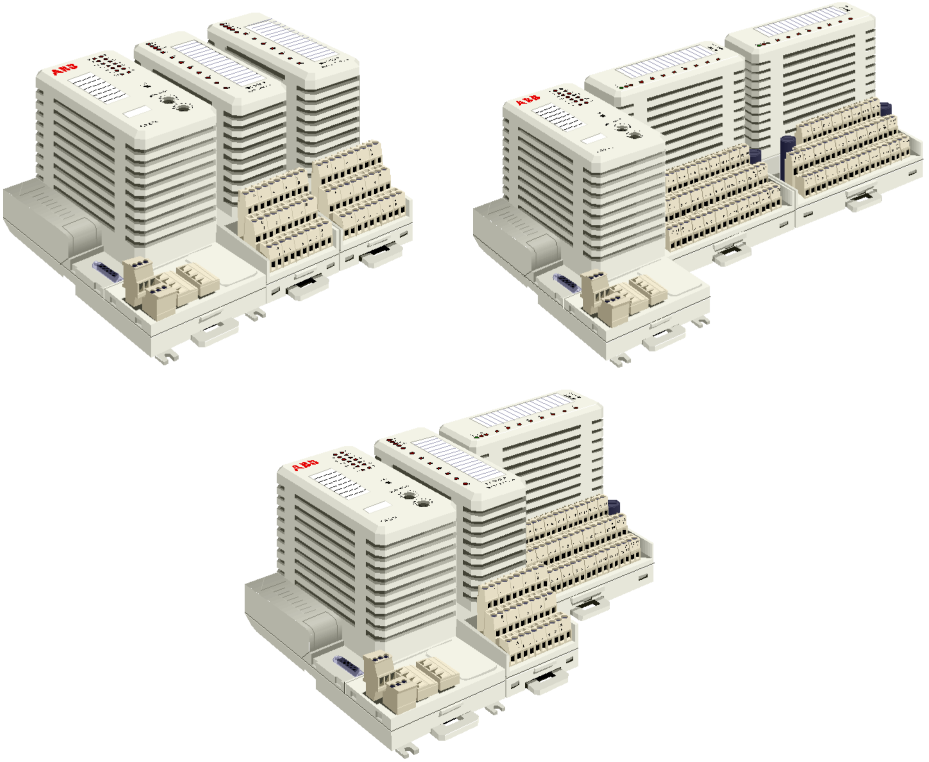


Figure 1-1. S800 I/O Fieldbus Communication Interface with an I/O Module on Compact and Extended MTUs

1.1 About This Book

This book provides a description of the S800 I/O standard modules and termination units. It provides instructions for site planning and installation, start-up and shutdown procedures, and information regarding capacity and performance. This book is not intended to be the sole source of instruction for the S800 I/O system.

This chapter provides introductory and background information including guidelines how to find information in the manual related documentation and a product and functional overview.

Chapter 2 guides in installation.

Chapter 3 will give you the information needed to obtain the desired function. The main information is structured as follow:

- Design considerations and guidelines are given.
- Capacity and performance.

Chapter 4 discusses the different start modes and operating modes

Chapter 5 focus is on fault finding supported by built in diagnostics and use of system status displays in operator station and LEDs on I/O modules.

Use of Warning, Caution, Information, and Tip

This publication includes **Warning**, **Caution**, and **Information** where appropriate to point out safety related or other important information. It also includes **Tip** to point out useful hints to the reader. The corresponding symbols should be interpreted as follows:

⚠ Warning indicates the presence of a hazard which could result in *personal injury*.

❗ Caution indicates the presence of a hazard which could result in *equipment or property damage*.

Information alerts the reader to pertinent facts and conditions.

Tip indicates advice on, for example, how to design your project or how to use a certain function.

Although **Warning** hazards are related to personal injury, and **Caution** hazards are associated with equipment or property damage, it should be understood that operation of damaged equipment could, under certain operational conditions, result in degraded process performance leading to personal injury or death. Therefore, comply fully with all **Warning** and **Caution** notices.

Those people involved in system engineering should attend the applicable system engineering or maintenance courses offered by ABB Automation University.

1.2 Product Overview

The S800 I/O provides easy installation of the I/O modules and process cabling. It is highly modularized and flexible so that the I/O modules can be combined to suit many applications. The S800 I/O modules and a Fieldbus Communication Interface (FCI) are combined to form an I/O Station.

For more overview information please see the *General Information and Installation manual*.

1.2.1 Product Scope

1.2.1.1 Module Termination Units

The Module Termination Units (MTU) are passive base units used to house the I/O modules. They contain the process wiring terminals and power supply terminals and a section of the ModuleBus.

The Module Termination Units (MTU) distributes the ModuleBus to the I/O module and to the next MTU. It also generates the correct address to the I/O module by shifting the outgoing position signals to the next MTU.

Two mechanical keys are used to configure the MTU for different types of I/O modules. This is only a mechanical configuration and it does not affect the functionality of the MTU or the I/O module. Each key has six positions, which gives a total number of 36 different configurations. The configuration can be changed with a screwdriver.

The MTU can be mounted on a standard DIN rail. It has a mechanical latch that locks the MTU to the DIN rail. The latch can be released with a screwdriver.

The MTU has a mechanical locking mechanism that locks the module in its position. This mechanism also gives the signal BLOCK to the I/O module that keeps the module in its init state until it is locked in its position.

The top part of the MTU can be removed to replace the termination board even with an operational system. Such a need can be caused by a damaged terminal screw.

The MTUs for Intrinsic Safety interfacing are available in a compact version and provides for a compact installation of the I/O modules and field circuit power distribution. See Figure 1-2 for an illustration of the MTUs together with the I/O modules.

See Table 3-1 for information about the combination between MTU and I/O modules and to specifications in Chapter A, References for more information.

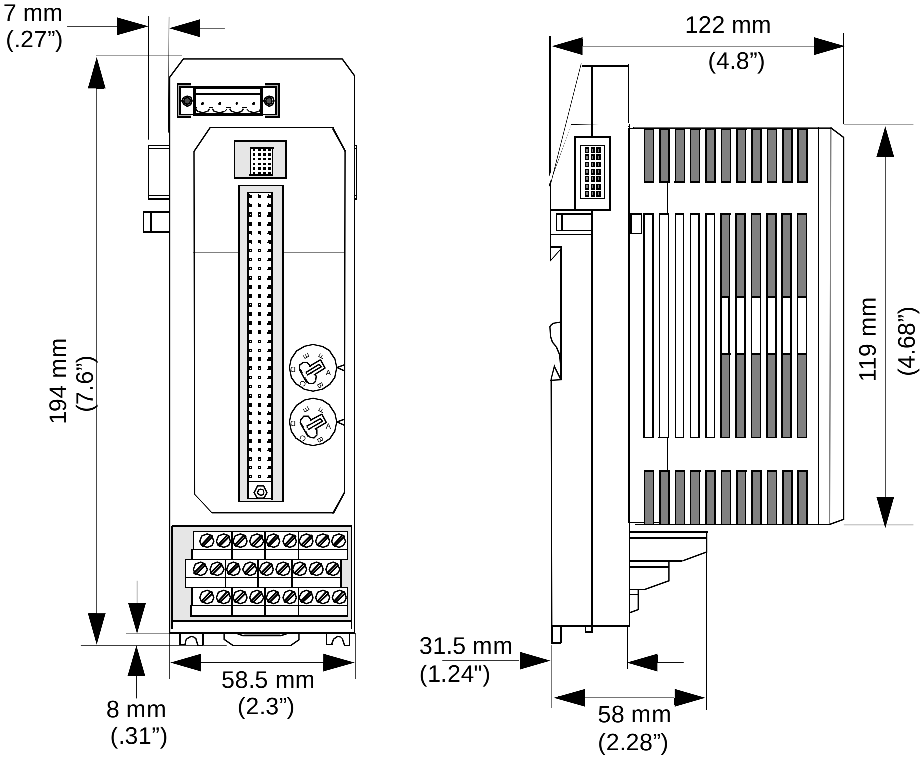


Figure 1-2. Typical Compact MTU without and with I/O Module

TU890 Intrinsic Safety Compact MTU

The TU890 is a compact module termination unit. It provides 27 blue colored field terminations to the I/O module, power supply terminations and connection to the ModuleBus of the communication interface (FCI or ModuleBus Modem).

The TU890 has three rows of blue terminals for field signals connections and a removable connector with four terminals for power supply. Power for the field circuits is routed through the IS I/O module which includes the protective interface components to achieve the Intrinsic Safety for the loop. The TU890 distributes the ModuleBus to the I/O module and to the next MTU. The correct ModuleBus address of this MTU is automatically configured when inserted into the previous MTU. To ensure the requisite separation of hazardous and non-hazardous wiring, an MTU wiring separator is included for use adjacent to the FCI or any standard S800 positions.

1.2.1.2 I/O Modules

The I/O modules have open ventilated plastic enclosures. On the front of each I/O module there are three LEDs (FAULT, RUN and WARNING) indicating the module status and digital I/O modules have a status LED for each channel. One additional LED (OSP) is included on analog output and digital output modules. Refer to Section 5.2, Hardware Indicators for the status indication of the LEDs.

I/O modules may be replaced in a fully operational I/O station. Mechanical keying on modules and MTUs protect I/O modules from being inserted in positions where they could be damaged by excessive voltage or current. An electronic type designation ID in each module keeps the I/O module from being taken into operation by the FCI, if a module's ID doesn't match the configured module type definition in the data base.

The modules also incorporate relevant protection components to implement Intrinsic Safety for connection to process instrumentation in hazardous areas.

Please refer to specifications in Chapter A, References for more information.

AI890 Analog Input Module, 0...20 mA

The AI890 Analog Input Module has 8 inputs for current signals or 2-wire transmitters. The inputs are independent for each channel, in that either current can be measured or a two-wire transmitter can be powered and operated. The current input is able to be connected to other IS circuits without further protection.

AO890 Analog Output Module, 0...20 mA

The AO890 Analog Output Module has 8 current outputs. State of outputs can be set to a predetermined (OSP) value if a communications error is detected. Open wire fault detection if output is set >1mA.

DI890 Digital Input Module, switch/prox.

The DI890 Digital Input Module has 8 channels. The inputs are fully isolated and can be connected to volt-free contacts or NAMUR proximity switches. Line faults can be detected and signalled.

DO890 Digital Output Module

The DO890 Digital Output Module has 4 channels for current sourcing digital outputs to drive I.S. solenoid valves. The outputs are fully isolated and include line fault detection of open or short circuits in the field. Faults can be detected in both the energized and non-energized state of the output. State of outputs can be set to a predetermined (OSP) value if a communications lost error is detected.

1.3 Prerequisites and Requirements

In order to use the S800 I/O modules, an FCI is needed.

1.4 Related Documentation

Table 1-1 lists all documentation related to the S800 I/O system.

Table 1-1. Related documents

Category	Title	Description
S800 I/O User's Guide	General Information and Installation	Describes the general installation and configuration information for the S800 I/O system
S800 I/O User's Guide	Modules and Termination Units	Describes the standard I/O modules and termination units in the S800 I/O system
S800 I/O User's Guide	Fieldbus Communication Interface for AF100	Describes the AF100 FCI in the S800 I/O system
S800 I/O User's Guide	Fieldbus Communication Interface for PROFIBUS-DP	Describes the PROFIBUS-DP FCI in the S800 I/O system

Table 1-1. Related documents

Category	Title	Description
S800 I/O User's Guide	PROFIBUS-DP Fieldbus Communication Interface, Reference Manual	Describes the memory mapping on PROFIBUS for the S800 I/O system
Installation	Interference-free Electronics	Describes the rule for the installation of equipment to ensure the correct operation of equipment in environments where disturbance are present
Installation	ABB Master Environmental Immunity	Contains a philosophy, theory, design and application of EMC on equipment and systems. This manual is valid of all ABB control systems and contains a summary of the ABB Master environmental factors
Installation	Advant Fieldbus 100 User's Guide	Describes the equipment and contains information required to install and commission AF100

1.5 Terminology

The following is a list of terms associated with terms that you should be familiar with.

Term	Description
FCI	The Fieldbus Communication Interface (FCI) device contains the interface to the fieldbus (for example AF 100), ModuleBus interface and power regulators. The FCI module can manage 24 I/O devices (up to 12 directly and to the others in 1 to 7 I/O clusters).
Base Cluster	Consists of single or red. FCIs plus I/O modules connected directly to the FCI.
I/O device	A complete I/O device consists of one MTU and one I/O module.

Term	**Description**
I/O module	Is the active, electronic and signal conditioning part of an I/O device.
I/O station	An I/O station consists of a base cluster with single or redundant FCI(s), 1-7 I/O clusters and up to 24 I/O devices.
ModuleBus	Is an incremental, electrical or optical, bus for interconnection of I/O devices.
MTU	The Module Termination Unit is a passive base unit containing process terminals and a part of the ModuleBus.
OSP	Outputs Set as Predetermined. A user configurable action on an output module when communications is lost to the FCI or Controller
RTD	Resistance Temperature Detector
SOE	Sequence of events. Time stamping of status changes for digital inputs.
TC	Thermocouple
I.S.	Intrinsic Safety is a protection technique to prevent explosion in hazardous areas of a process plant

Chapter 2 Installation

Please also see the *S800 I/O General Information and Installation User's Guide.*

2.1 Hazardous Area Interfacing

Correct and safe operation of the Intrinsic Safety aspects of MTU and I/O Modules with Intrinsic Safety interfaces calls for expert installation and commissioning as well as correct operation and meticulous maintenance. Only those persons conversant with the installation commissioning, operation and maintenance of similar apparatus and who has the necessary qualifications should work on these products.

Make sure installation is carried out observing the safety regulations pertaining to the installation and operation of electrical systems and the directives and guidelines on explosion protection (Hazardous Area equipment should comply with the descriptive system document).

The installation must be performed by qualified personnel. It must comply with the relevant national/international standards (e.g. IEC 79-14, CEI 64-2, BS 5345 Pt. 4, DIN VDE 165) and in line with the established installation rules and recommended practice (for example CEI 64-8, ANSI/ISA RP-12.6). The conformity of hazardous area field devices with the related system documentation must always be checked.

This instrumentation IS NOT intended for hazardous area installation unless it is included in a suitable enclosure which conforms to the applicable standards.
To mount the equipment in a Zone2 hazardous area then an enclosure or cabinet which provides ingress protection of IP54 rating is required.

For I.S. applications, the maximum limit for AC power supply is 250 Vrms and the user must ensure that the DC power supply to the FCI and I/O is limited to 60V.

2.2 General description of an I.S. system

An Intrinsically Safe system is composed of an assembly of intrinsically safe apparatus, associated apparatus and interconnecting cables, where the following definitions apply:

- Simple Electrical Apparatus

  Apparatus in which neither of the following electrical parameters are exceeded: 1.2 V 0.1 A (Generated) 20 mJouIes (Stored) 25 mW (Dissipated), in this case the Apparatus does not require any certificate or labeling. (Typical examples can be Thermocouples, Resistance Temperature Detectors, Contacts, Strain Gauges, Light Emitting Diodes, photocells).

- Intrinsically Safe Apparatus

  Apparatus in which all circuits are intrinsically safe. It must have suitable approval for the hazardous (classified) location where it will be mounted and must have a control drawing that specifies safety parameters: Ui; Ii; Pi; Ci; Li (i.e. Proximity Switches, Transmitters, Active Sensors, magnetic pick-up) must be Intrinsically Safe Certified.

- Associated Apparatus

  Apparatus in which circuits may affect the energy in the intrinsically safe circuits to which it is connected. It must have suitable approval for connection to devices in the hazardous (classified) location. Associated apparatus safety parameters are specified as: Uo; Io; Po; Co; Lo.
  Associated apparatus and control room equipment shall not be powered or generate any voltage greater than 250 Volts.

2.3 System design considerations

The system must be evaluated under the "entity concept" where the following rules apply:

To determine acceptable combination of intrinsically safe apparatus and connected associated apparatus the following conditions must be valid:

$U_i > U_o$

$I_i > I_o$

$P_i > P_o$

The length of interconnecting cable shall be determinate in accordance with the maximum allowed parameters by the associated apparatus according to the expression:

$C_{cable} < C_o - C_i$

$L_{cable} < L_o - L_i$

When an Hand Held Configurator (HHC) is connected to intrinsically safe terminals, values of Ci and Li for such equipment must also be considered in calculating the maximum allowed parameters. A HHC terminal must also have suitable approvals. Otherwise it can not be connected to the intrinsically safe circuit.

2.4 Wiring of intrinsically safe circuits

Installation shall be in accordance with Intrinsic Safety standards and installation rules (for example IEC 79-14, ANSI/ISA RP 12.6), applicable in the Country where the application is made. Intrinsically safe circuits shall be so identified.

Color coding may be used for identification if the color used is light blue and no other wiring is color coded light blue. Other identification means may be for example: signs, tags, markings which shall be visible after installation.

Wiring of intrinsically safe circuits shall be positively separated from non intrinsically safe wiring (such as power wiring) by one of the following methods:

- Using separated raceway
- Providing an insulating or grounded metal partition
- Spacing of at least 50 mm and separately tied down.

Different intrinsically safe circuits shall not be run in the same multiconductor cable unless at least 0.25 mm thick insulation is used on each conductor.

Cables, raceways or conduits used to contain intrinsically safe circuits must not transmit flammable atmosphere from hazardous to non hazardous location. Otherwise they must be sealed or vented.

The wiring separator provided with the TU890 MTU ensures that intrinsically safe circuit wiring and the I.S. field terminals on the TU890 are segregated from wiring and terminals of the FCI or standard non-IS MTU. The separator should be applied on the first TU890 adjacent to the FCI and to any TU890 adjacent to a non-IS MTU.

2.5 Grounding information

Grounding of intrinsically safe circuits *is not required* when connected to associated apparatus having galvanic isolation between intrinsically safe circuit and all the other circuits. Should grounding be necessary, for functional reasons, only one point of the intrinsically safe circuit must be grounded.

In case of using shielded cables, proper shield grounding (if needed) shall be provided at one point only. Metallic enclosures of field devices must be grounded.

2.6 Mounting equipment in Zone2 hazardous areas

Before mounting any equipment in a Zone2 hazardous area of a process plant it must be ensured that all products are suitably marked and appropriate safety approval documentation is available.

In general, equipment and installation should comply with IEC 79-14 and the user should refer to this document for complete guidance on this issue.

The following are a few key points for consideration when mounting in Zone2 in addition to the factors involved in Intrinsic Safety interfacing.

- The enclosure or cabinet must provide a Degree of Protection of at least IP54 for any bare live parts and at least IP44 for insulated parts. Thus it is recommended that an enclosure rated at IP54 minimum is used to give good protection and a secure environment.
- All wire entries should make use of cable glands and blanking plugs to maintain the IP rating of the enclosure. The use of glands and blanking plugs with Ex e approval is preferred since this will ensure correct practice, but otherwise normal items which meet the IP54 criteria can be applied.
- Check that the power supply output voltage has limitation to within the maximum ratings of the connected equipment under normal operating conditions.
- Labelling of all products must conform to the safety requirements and the enclosure carry appropriate statements in the language of the country of use that it must not be opened whilst energized.

Chapter 3 Configuration

3.1 Before You Start

3.1.1 Module Termination Units (MTU)

Each MTU is used with certain types of I/O Modules. Refer to Table 3-1 for a cross-reference between MTU and I/O Modules. Each MTU has two mechanical keys that have to be set for the type of I/O module that will be installed on it.

Table 3-1. MTU Usage and Key Settings

Module Type	TU890 Compact	Mech. Key Setting(1)	
		Key 1	Key 2
AI890	X	A	C
AI895	X	A	E
AO890	X	A	D
AO895	X	A	F
DI890	X	A	A
DO890	X	A	B

(1) Note that the shape and style of key on the TU890 MTU is different from the standard MTU's.

Connecting an MTU to the FCI or to another MTU automatically sets-up the address selection of that MTU. There are no jumpers or switches that need to be set before installing an I/O module.

MTUs are placed on the DIN rails and then connected to the preceding MTU or FCI. Once connected, the MTU is locked in place by the bottom latch which also bonds it to the chassis ground.

3.1.2 I/O Modules

Each I/O module is installed onto an MTU. See Table 3-1 for which MTU to use with each I/O module type. I/O modules do not have any jumpers or switches that need to be set before installing on an MTU. Refer to Chapter A, References for more information.

I/O modules are installed by aligning the connectors of the MTU and I/O module and then pushing the units together. After connected to the MTU, the I/O module is then locked in place by the I/O Module Lock/Switch which also activates a switch to enable power to the I/O module.

Chapter 4 Operation

See the relevant controller manuals for information.

Chapter 5 Maintenance

5.1 Preventive Maintenance

⚠ Particular attention should be paid to any safety regulations and regular visual inspection should be carried out of the safety element. For more information, please see the *S800 I/O General Information and Installation User's Guide*.

5.2 Hardware Indicators

5.2.1 I/O Module LEDs

Figure 5-1 shows examples of front panels for different types of I/O modules. On the front of each I/O module there are three LEDs (FAULT, RUN and WARNING) indicating the module status. One additional LED (OSP) is included on output modules. See Table 5-1 and Table 5-2 for information on the meaning and indications for these modules. For modules with special LED indications see respectively module in Appendix A, References.

The FAULT LED shall indicate when the I/O module detect a fatal error or before first access after power up. The RUN LED shall indicate when the I/O module is operational. The WARNING LED shall indicate when a non-fatal error is detected and the module continues to run. The OSP LED shall indicate when the I/O module is commanded to OSP state or when the module detects that there is no communication to the module.

Each digital channel has one LED indicating current state (on/off) and one LED indicating channel fault.

Table 5-1. Standard LEDs on I/O Modules

Marking	Color	Description
F (Fault)	Red	Fault in the module (1)
R (Run)	Green	Operational state
W (Warning)	Yellow	External fault or minor fault in the module, that is, low process voltage
O (OSP)	Yellow	OSP state (Outputs Set as Predetermined)
Digital I/O on state	Yellow	Digital I/O signal on-state
Digital I/O fault	Red	Digital I/O channel line fault

(1) Modules without self test function e.g. DI/DO modules: The F-LED will switch on at power up or restart of the module and switch off after the first successful access to the module.
Modules with self test function for example, AI/AO modules: The F-LED will switch on at power up, restart of the module or when the module goes to Error state. If the module has not gone to Error state it will switch off the F-LED after the first successful access to the module.

Table 5-2. I/O Module LED Indications in Different States

Module State	Run	Fault	Warning	OSP	Signal status
Init	off	on	off	off	DI on/off, DO off
Not Configured	off	on/off (1)	on/off	off	DI on/off, DO off
Ready	off	off	on/off	off	DI on/off, DO off
Operational	on	off	on/off	off	on/off
OSP	on	off	on/off	on	on/off
Error	off	on	off	off	DI on/off, DO off

(1) Will be switched off after the first successful access to the module.

Normally when an I/O module has been removed from the configuration, the FCI will do a restart of the module. The module will end up in the NOT CONFIGURED mode.

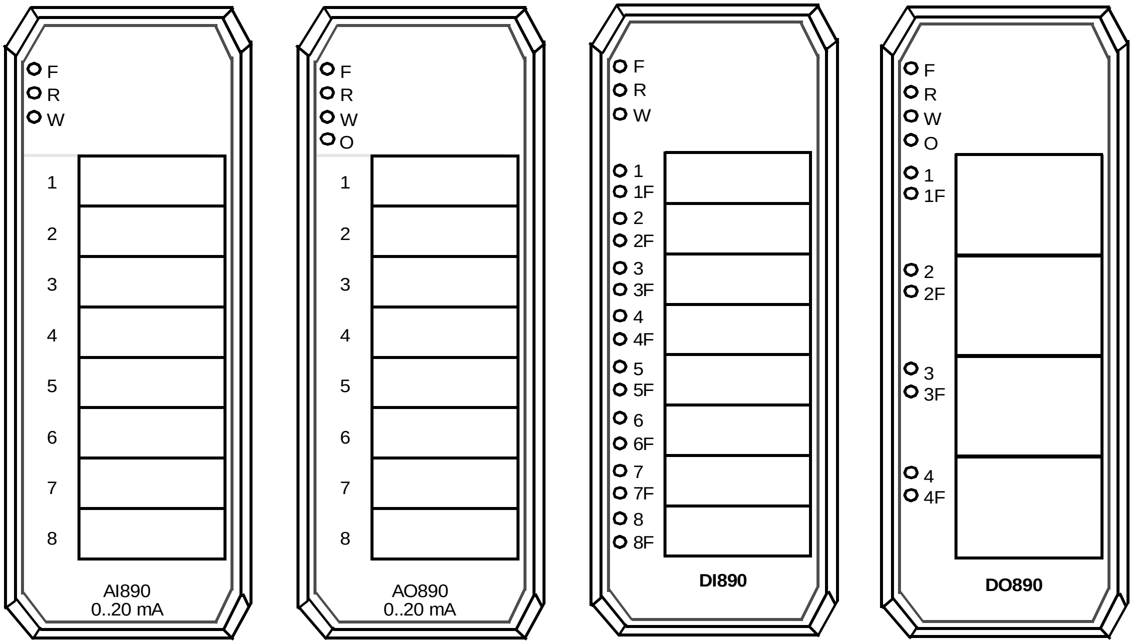


Figure 5-1. Examples of I/O Module LED Locations

5.3 Error Messages

Please see the relevant controller manuals.

5.4 Fault Finding and User Repair

5.4.1 I/O Module Replacement

General

All I/O modules can be exchanged on-line an with the process power supply connected. This is possible because the module deactivates when the I/O module lock switch is turned to unlock.

It is important to understand the consequences of a module exchange on-line and how it affects the process. Replacement of an S800 I/O module affects all channels on the module. It also sometimes indirectly affects the outputs via some application function, on another module.

The system software in the FCI checks automatically that all I/O modules function correctly. In the event of module fault, and module exchange, the module and associated signals are marked as faulty.

The system software checks that the module is inserted and correct. If this is the case, the Fault-indicator (LED) extinguishes (after 10 seconds), the fault marking in the data base is reset and the module resumes its normal function.

The following headings include general instructions for replacement of modules and aspects on the handling of individual modules are presented in Table 5-3.

Practical Execution

Replace faulty or suspect I/O modules in the following way:

1. Read *S800 General Information and Installation manual.*
2. Special restrictions apply to each module type. See descriptions in Table 5-3 for useful information on individual module types.
3. Check that the new module can replace the old.
4. Provide access to the module by loosening the module locking.
5. Grip the module firmly and extract the module.
6. Insert the new module carefully.

7. Store extracted modules in envelopes.
8. Ensure that the module contacts mate properly with the contacts in the MTU and activate the locking mechanism in place.
9. Modules initialized automatically by the system and the fault indicating LED extinguishes automatically after approximately 10 seconds.
10. Perform a function test on the new module.

Additional Aspects on Individual S800 I/O Modules

Table 5-3 lists S800 I/O modules. Descriptions of these types are referred individually in the table.

Table 5-3. Replacement Aspects of S800 I/O Modules

Module Type - Settings		Comments
AI890 **Analog Input**	No settings	Replacement with power applied is possible. Turning locking mechanism deactivates the module.
AO890 Analog Output	No settings	Replacement with power applied is possible. It may be necessary to disconnect the output connection to the process or set the process device manually to a safe state before the module is extracted. Turning locking mechanism deactivates the module.
DI890 **Digital Input**	No settings	Replacement with power applied is possible. Turning locking mechanism deactivates the module.

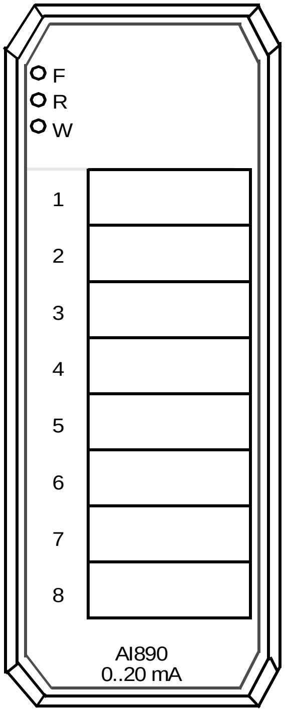
Table 5-3. Replacement Aspects of S800 I/O Modules (Continued)

Module Type - Settings		Comments
DO890 **Digital Output**	No settings	Replacement with power applied is possible. It may be necessary to disconnect the output connection to the process or set the process device manually to a safe state before the module is extracted. Turning locking mechanism deactivates the module.
TU890 MTUs	No settings	Cannot be replaced or repaired with power applied. Disconnecting an MTU breaks the ModuleBus communications bus and removes power to the MTUs that follow. MTUs mounted in the middle (between the FCI and the number 12 MTU) need to have the preceding or following MTUs moved in order to disconnect the ModuleBus connector.

⚠ Observe all local requirements for working with signals into or from hazardous areas when removing or inserting modules under power.

Appendix A References

A.1 AI890 Analog Input Module, 0...20 mA



Features

- 8 channels for 0...20 mA or 4...20 mA, single ended unipolar inputs
- 1 group of 8 channels isolated from ground
- 12 Bit resolution
- Power and monitor for Ex certified two-wire transmitters
- Non energy-storing analog inputs for externally powered sources
- EMC protection
- DIN rail mounting.

Description

The AI890 Analog Input Module has 8 channels. The module includes Intrinsic Safety protection components on each channel for connection to process equipment in hazardous areas without the need for additional external devices.

Each channel can be either a current input or power and monitor a two-wire process transmitter. The current input is for externally powered transmitters. The input voltage drop of the current input is typically 3V, PTC included. The transmitter supply for each channel is able to provide at least 15V at a 20mA loop current to power Ex certified process transmitters and is limited to 23mA in overload conditions.

All eight channels are isolated from the ModuleBus and power supply in one group. Power to the input stages is converted from the 24V on the power supply connections.

Three LEDs indicate module status Fault (Red), Run (Green) and Warning (Yellow). The RUN LED

indicates normal operation and the WARNING LED indicates if any error input is active.
The FAULT LED indicates that the module is in Init state or Not configured state. In Not configured state the FAULT LED is turned off after the first valid access to the module.

The reset circuitry gives a reset signal when the module is inserted until the BLOCK signal is inactive and the POWOK signal is active. The BLOCK signal is deactivated when the module lock mechanism is in the locked position. The POWOK comes from the FCI after power is applied.

Only the TU890 Compact MTU can be used with this module and it enables two wire connection to the process devices without additional terminals.

Technical Data

Table A-1. AI890 Analog Input Module Specifications at 25°C

Feature	AI890 Analog Input Module
Number of channels	8
Type of input	Unipolar single ended
Measurement range	0...20 mA
Over/under range	-0.5 - 22.5 mA
Available output voltage	15 V at 20 mA
Input voltage drop for current source	3 V typical
Maximum field cable length	Defined by safety parameters
NMRR, 50 Hz, 60 Hz	>20 dB
CMRR, 50 Hz, 60 Hz	>80 dB
Intrinsic error (IEC51-1)	Max. 0.1%
Resolution	12 bit
Temperature drift	Typ. 50 ppm/°C Max. 100 ppm/°C
Update cycle time	5 ms

Table A-1. AI890 Analog Input Module Specifications at 25°C (Continued)

Feature	**AI890 Analog Input Module**
Current consumption 24V external	200 mA
Current consumption 5V Modulebus	70 mA
Power dissipation	1.5 W
Voltage supervision	Internal process supply
Input filter (rise time)	75 ms
Isolation	Groupwise isolated from ground (RIV=50V)
Mounting termination units	TU890
MTU keying code	AC
Safety classification	Class I according to IEC 536; (earth protected)
Protection rating	IP20 according to IEC 529, (IEC 144)
Rated insulation voltage	50V
Dielectric test voltage	500V a.c.
Width	45 mm (1.77")
Depth	97 mm (3.8"), 106 mm (4.2") including connector
Height	119 mm (4.7")
Weight	0.2 kg (0.44 lbs.)

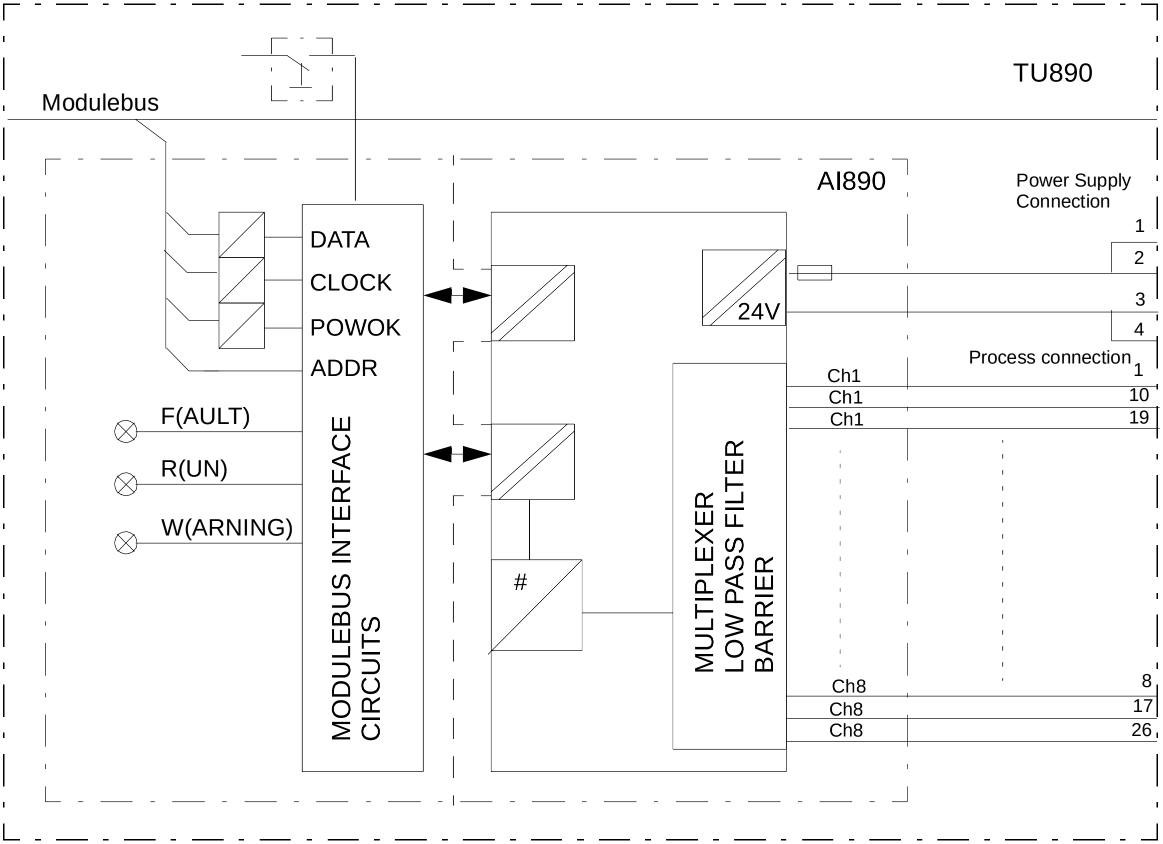
Intrinsic Safety Parameters

Table A-2. AI890 Analog Input Module Intrinsic Safety Parameters

Terminals	Safety description	Maximum external parameters				
		Groups CENELEC USA		**C_0 (uF)**	**L_0 (mH)**	**L/R (uH/O)**
Powered transmitter terminals	$U_0 = 27$ V	IIC	AB	0.097	4.1	58
	$I_0 = 93$ mA	IIB	CE	0.74	16.5	230
	$P_0 = 620$ mW	IIA	DFG	2.51	33	470
Passive input terminals(1)	$U_0 = 1.2$ V	IIC	AB	-	-	-
	$I_0 = 50$ mA	IIB	CE	-	-	-
	$P_0 = 25$ mW	IIA	DFG	-	-	-

(1) Non energy-storing apparatus connection

Block Diagram AI890



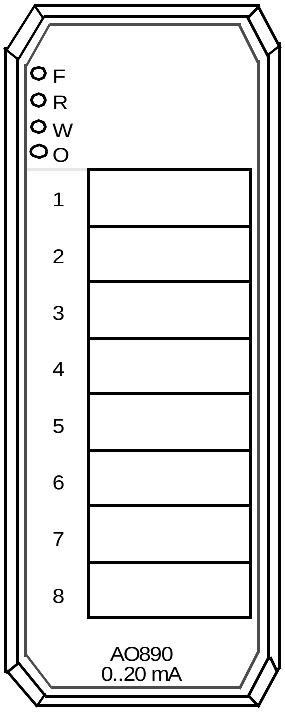
Process Connections

Table A-3. AI890 Process Connections

Process Connection	**TU890 Terminal**
Ch1 Tx. +ve	1
Ch1 Tx. -ve, mA +ve	10
Ch1 mA. -ve	19
Ch2 Tx. +ve	2
Ch2 Tx. -ve, mA +ve	11
Ch2 mA. -ve	20
Ch3 Tx. +ve	3
Ch3 Tx. -ve, mA +ve	12
Ch3 mA. -ve	21
Ch4 Tx. +ve	4
Ch4 Tx. -ve, mA +ve	13
Ch4 mA. -ve	22
Ch5 Tx. +ve	5
Ch5 Tx. -ve, mA +ve	14
Ch5 mA. -ve	23
Ch6 Tx. +ve	6
Ch6 Tx. -ve, mA +ve	15
Ch6 mA. -ve	24
Ch7 Tx. +ve	7
Ch7 Tx. -ve, mA +ve	16
Ch7 mA. -ve	25
Ch8 Tx. +ve	8
Ch8 Tx. -ve, mA +ve	17
Ch8 mA. -ve	26

A.2 AO890 Analog Output Module, 0...20 mA

Features



- 8 channels of 0...20 mA, 4...20 mA outputs
- 1 group of 8 channels isolated from ground
- Power to drive Ex certified I/P actuators
- OSP sets outputs to predetermined state upon error detection
- EMC protection
- DIN rail mounting.

Description

The AO890 Analog Output Module has 8 channels. The module includes Intrinsic Safety protection components on each channel for connection to process equipment in hazardous areas without the need for additional external devices.

Each channel can drive up to 20mA loop current into a field load such as an Ex certified current-to-pressure converter and is limited to 22mA in overload conditions.

All eight channels are isolated from the ModuleBus and power supply in one group. Power to the output stages is converted from the 24V on the power supply connections.

Four LEDs indicate module status Fault (Red), Run (Green), OSP (Yellow) and Warning (Yellow). The RUN LED indicates normal operation and the WARNING LED indicates if any error input is active. The FAULT LED indicates that the module is in Init state or Not configured state. In Not configured state the FAULT LED is turned off after the first valid access to the module. The OSP LED is turned on when the output is set to the predetermined OSP value.

The module performs self-diagnostic checks cyclically. Module diagnostics include: Process power supply supervision which is reported when supply voltage to the output circuitry is too low.
This error is reported but the module will continue to function within the power supply limits because the output current is supervised. Channel diagnostics include: Fault detection of the channel

(only reported on active channels). Open circuit of the field wiring is only detected if the output set is greater than 1 mA.

The outputs of the module will be set to a predetermined value if the OSP-watchdog timer expires or ordered by the FCI. The watchdog timer which is in the range 256ms-1024ms is used for modulebus supervision. Three different values are possible, 256, 512 and 1024ms. The watchdog timer can also be disabled, which is the default after reset or power-up. The watchdog timer is re-triggered every time the correct node address has been decoded (or broadcast). If the watchdog timer expires or if the SetOSPState command is received, the module enters the OSP state and the active outputs (if any) are set to their OSP values which can be configured as a predefined value or to the last good value sent.

The output values will be kept as long as the module stays in the OSP state. To change the outputs the module first has to leave this state. This is done with an explicit command or if the BLOCK or POWOK signal is activated. When reentering Operational State, the outputs are still kept within their OSP value until new valid values are written.

The reset circuitry gives a reset signal when the module is inserted until the BLOCK signal is inactive and the POWOK signal is active. The BLOCK signal is deactivated when the module lock mechanism is in the locked position. The POWOK comes from the FCI after power is applied.

Only the TU890 Compact MTU can be used with this module and it enables two wire connection to the process devices without additional terminals.

Technical Data

Table A-4. AO890 Analog Output Module Specifications at 25°C

Feature	AO890 Analog Output Module
Number of channels	8
Type of output	Unipolar single ended
Output range	0(4)...20 mA
Over/under range	-0.5 - 22.5 mA

Table A-4. AO890 Analog Output Module Specifications at 25°C (Continued)

Feature	**AO890 Analog Output Module**
Output load	<750 ohms at 20 mA, no over-range <650 ohms at up to 22 mA
Load effect factor	Max. 0.1% from 0 to 650 ohms
Maximum field cable length	Defined by safety parameters
Intrinsic error (IEC51-1)	Max. 0.1% at 0 - 500 ohms
Resolution	12 bit
Output Set as Predetermined (OSP) timer	256, 512, 1024 ms
Temperature drift	Typ. 50 ppm/°C Max. 100 ppm/°C
Current consumption 24V external	200 mA
Current consumption 5V Modulebus	70 mA
Power dissipation (1)	3.1 W
Voltage supervision	Internal process supply
Open wire detection	If output is set to > 1mA.
Isolation	Groupwise isolated from ground (RIV=50V)
Mounting termination units	TU890
MTU keying code	AD
Safety classification	Class I according to IEC 536; (earth protected)
Protection rating	IP20 according to IEC 529, (IEC 144)
Rated insulation voltage	50V

Table A-4. AO890 Analog Output Module Specifications at 25°C (Continued)

Feature	**AO890 Analog Output Module**
Dielectric test voltage	500V a.c.
Width	45 mm (1.77”)
Depth	97 mm (3.8”), 106 mm (4.2”) including connector
Height	119 mm (4.7”)
Weight	0.2 kg (0.44 lbs.)

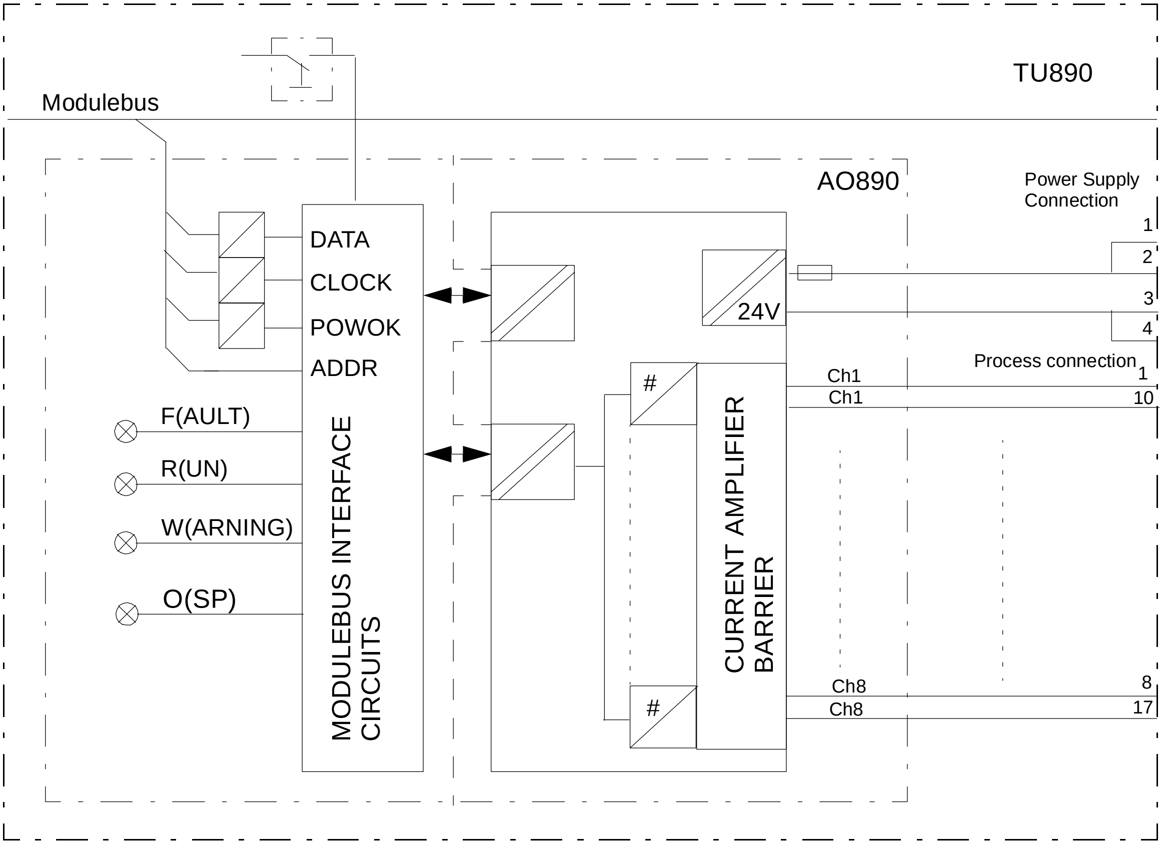
(1) 250 ohm load, 70% of nominal current, all channels activated. Supply L+ connected.

Intrinsic Safety Parameters

Table A-5. AO890 Analog Input Module Intrinsic Safety Parameters

Terminals	**Safety description**	**Maximum external parameters**				
		Groups CENELEC	**USA**	**C_0 (uF)**	**L_0 (mH)**	**L/R (uH/O)**
Powered output terminals	U_0 = 27 V	IIC	AB	0.097	4.1	58
	I_0 = 93 mA	IIB	CE	0.74	16.5	230
	P_0 = 620 mW	IIA	DFG	2.51	33	470

Block Diagram AO890



Process Connections

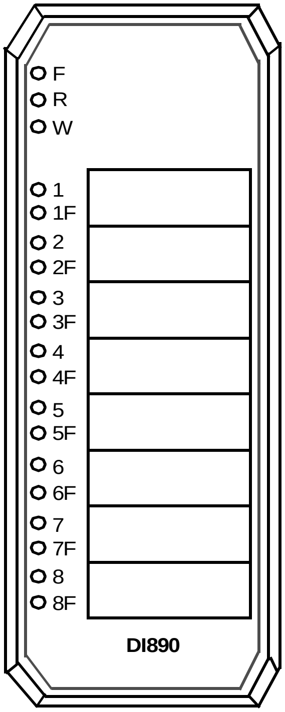
Table A-6. A0890 Process Connections

Process Connection	**TU890 Terminal**
Ch1 O/P. +ve	1
Ch1 O/P. -ve	10
-	-
Ch2 O/P. +ve	2
Ch2 O/P. -ve	11
-	-
Ch3 O/P. +ve	3
Ch3 O/P. -ve	12
-	-
Ch4 O/P. +ve	4
Ch4 O/P. -ve	13
-	-
Ch5 O/P. +ve	5
Ch5 O/P. -ve	14
-	-
Ch6 O/P. +ve	6
Ch6 O/P. -ve	15
-	-
Ch7 O/P. +ve	7
Ch7 O/P. -ve	16
-	-
Ch8 O/P. +ve	8
Ch8 O/P. -ve	17
-	-

A.3 DI890 Digital Input Module, switch/prox.

Features

- 8 channels for switch or proximity sensor inputs
- All channels fully isolated
- Ex proximity sensor interface with line fault detection
- Volt-free contact interface (line fault detection with external resistors)
- Input and fault status indicators for each channel
- EMC protection
- DIN rail mounting.



Description

The DI890 Digital Input Module has 8 channels. The module includes Intrinsic Safety protection components on each channel for connection to process equipment in hazardous areas without the need for additional external devices.

Each channel is galvanically isolated from the power supply, ground, and each other. Intrinsically safe Proximity sensors or volt-free contacts can be powered and monitored by any channel. The Proximity sensor should conform to the NAMUR standard and line faults can be detected without any additional external components. For line faults to be detected when using volt-free contacts, external resistors should be connected in series and in parallel to enable the state of the field circuit to be sensed by the input channel.

All eight channels are isolated from the ModuleBus and power supply individually. Power to the input stages is converted from the 24V on the power supply connections.

Three LEDs indicate module status Fault (Red), Run (Green) and Warning (Yellow). The RUN LED indicates normal operation and the WARNING LED indicates if any error input is active.
The FAULT LED indicates that the module is in Init state or Not configured state. In Not configured state the FAULT LED is turned off after the first valid access to the module.

In addition there are two LEDs for each channel to show CHANNEL STATE (Yellow) (On = 1 and Off = 0) and CHANNEL FAULT (Red). The channel fault indication can be disabled when not required.

The reset circuitry gives a reset signal when the module is inserted until the BLOCK signal is inactive and the POWOK signal is active. The BLOCK signal is deactivated when the module lock mechanism is in the locked position. The POWOK comes from the FCI after power is applied.

The input channels can be digitally filtered. The different filter times that can be achieved are 2, 4, 8 and 16ms. This means that noise pulses shorter than the filter time will not be registered and pulses longer than 3, 6, 12 and 24ms will get through the filter.

Only the TU890 Compact MTU can be used with this module and it enables two wire connection to the process devices without additional terminals.

Technical Data

Table A-7. DI890 Digital Input Module Specifications

Feature	DI890 Digital Input Module
Number of channels	8
Type of input	Proximity sensor (NAMUR) or volt-free contact(1)
Digital input status	"0" - input contact open "1" - input contact closed (LED on)
Digital fault status (can be disabled)	"0" - no input fault "1" - input fault (LED on)
Threshold values I=input current R=input load	I<50 uA open wire (fault)
	0.2<I<1.2 mA contact open for proximity switch
	I>2.1 mA and R>360 ohms contact closed (no prox.)
	R<100 ohms short wire (fault)

Table A-7. DI890 Digital Input Module Specifications (Continued)

Feature	**DI890 Digital Input Module**
Maximum field cable length	Defined by safety parameters
Filter times (digital, selectable)	2, 4, 8, 16 ms
Voltage supervision	Internal process supply
Current consumption +24V external	50 mA
Current consumption +5V Modulebus	50 mA
Power dissipation (2)	1.4 W
Input filter (rise time)	1 ms
Isolation	Each channel isolated from power, ground and each other
Mounting termination units	TU890
MTU keying code	AA
Safety classification	Class I according to IEC 536; (earth protected)
Protection rating	IP20 according to IEC 529, (IEC 144)
Rated insulation voltage	50V
Dielectric test voltage	500V a.c.
Width	45 mm (1.77”)
Depth	97 mm (3.8”), 106 mm (4.2”) including connector
Height	119 mm (4.7”)
Weight	0.2 kg (0.44 lbs.)

(1) Fault detection with volt-free contacts requires 1 kohm plus 10 kohm parallel external resistors

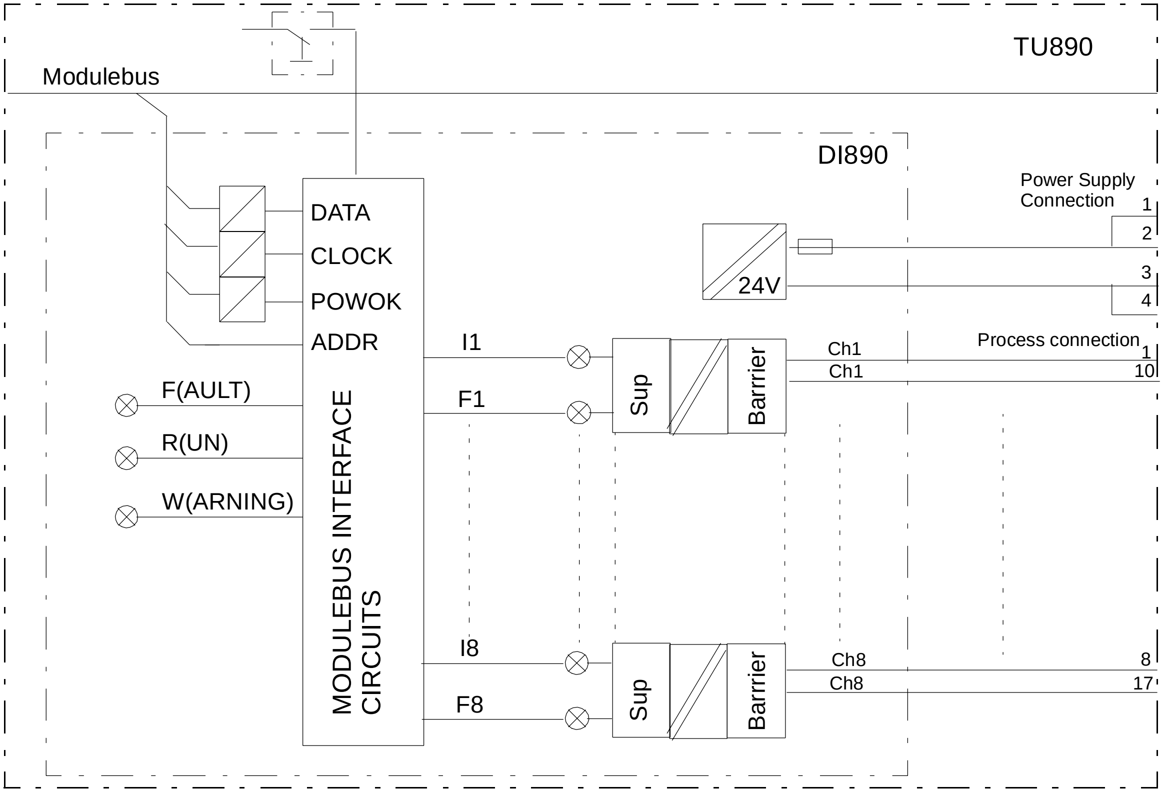
(2) Power dissipation is calculated with 70 percent of the channels activated at nominal voltage of 24 Volts.

Intrinsic Safety Parameters

Table A-8. DI890 Analog Input Module Intrinsic Safety Parameters

Terminals	Safety description	Maximum external parameters				
		Groups CENELEC USA		C_0 (uF)	L_0 (mH)	L/R (uH/O)
Input terminals	U_0 = 11V	IIC	AB	1.97	80	595
	I_0 = 21 mA	IIB	CE	13.8	320	2382
	P_0 = 0.058 mW	IIA	DFG	60	640	4765

Block Diagram DI890



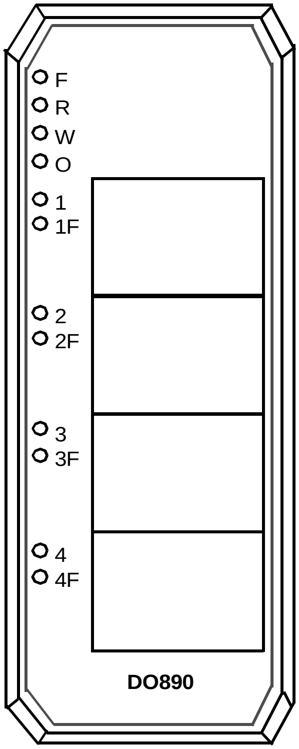
Process Connections

Table A-9. DI890 Process Connections

Process Connection	**TU890 Terminal**
Ch1 I/P. +ve	1
Ch1 I/P. -ve	10
-	-
Ch1 I/P. +ve	2
Ch1 I/P. -ve	11
-	-
Ch1 I/P. +ve	3
Ch1 I/P. -ve	12
-	-
Ch1 I/P. +ve	4
Ch1 I/P. -ve	13
-	-
Ch1 I/P. +ve	5
Ch1 I/P. -ve	14
-	-
Ch1 I/P. +ve	6
Ch1 I/P. -ve	15
-	-
Ch1 I/P. +ve	7
Ch1 I/P. -ve	16
-	-
Ch1 I/P. +ve	8
Ch1 I/P. -ve	17
-	-

A.4 DO890 Digital Output Module

Features



- 4 channels for 12V, 40 mA digital outputs
- All channels fully isolated
- Power to drive Ex certified solenoid valves and alarm sounders
- Output and fault status indicators for each channel
- OSP sets outputs to predetermined state upon error detection
- EMC protection
- DIN rail mounting.

Description

The DO890 Digital Output Module has 4 channels. The module includes Intrinsic Safety protection components on each channel for connection to process equipment in hazardous areas without the need for additional external devices.

Each channel can drive a nominal current of 40mA into a 300 ohm field load such as an Ex certified solenoid valve, alarm sounder unit or indicator lamp.

Open and short circuit detection can be implemented for each channel

All four channels are isolated from the ModuleBus and power supply in one group. Power to the output stages is converted from the 24V on the power supply connections.

Four LEDs indicate module status Fault (Red), Run (Green), OSP (Yellow) and Warning (Yellow). The RUN LED indicates normal operation and the WARNING LED indicates if any error input is active. The FAULT LED indicates that the module is in Init state or Not configured state. In Not configured state the FAULT LED is turned off after the first valid access to the module. The OSP LED is turned on when the output is set to the predetermined OSP value.

In addition there are two LEDs for each channel to show CHANNEL STATE (Yellow) (On = 1 and Off = 0) and CHANNEL FAULT (Red). The channel fault indication can be disabled when not required.

The module performs self-diagnostic checks cyclically. Module diagnostics include: Process power supply supervision which is reported when supply voltage to the output circuitry is too low. This error is reported but the module will continue to function within the power supply limits because the output current is supervised. Channel diagnostics include: Fault detection of the channel (only reported on active channels). Fault detection of the field wiring is carried out in both the "energized" and "de-energized" state of the output channel.

The outputs of the module will be set to a predetermined value if the OSP-watchdog timer expires or ordered by the FCI. The watchdog timer which is in the range 256ms-1024ms is used for modulebus supervision. Three different values are possible, 256, 512 and 1024ms. The watchdog timer can also be disabled, which is the default after reset or power-up. The watchdog timer is re-triggered every time the correct node address has been decoded (or broadcast). If the watchdog timer expires or if the SetOSPState command is received, the module enters the OSP state and the active outputs (if any) are set to their OSP values which can be configured as a predefined value or to the last good value sent.

The output values will be kept as long as the module stays in the OSP state. To change the outputs the module first has to leave this state. This is done with an explicit command or if the BLOCK or POWOK signal is activated. When reentering Operational State, the outputs are still kept within their OSP value until new valid values are written.

The reset circuitry gives a reset signal when the module is inserted until the BLOCK signal is inactive and the POWOK signal is active. The BLOCK signal is deactivated when the module lock mechanism is in the locked position. The POWOK comes from the FCI after power is applied.

Only the TU890 Compact MTU can be used with this module and it enables two wire connection to the process devices without additional terminals.

Technical Data

Table A-10. DO890 Digital Output Module Specifications

Feature	DO890 Digital Output Module
Number of channels	4
Type of output	Solenoid driver
Output range	See characteristic see Figure A-1

Table A-10. DO890 Digital Output Module Specifications (Continued)

Feature	**DO890 Digital Output Module**
Output load	100<Load<5000 ohms
Short circuit fault detection limit	<20 ohms
Open circuit fault detection limit	>100 kohms
Fault sense current	<4 mA
Digital output status	"0" - output de-energized "1" - output energized (LED on)
Digital fault status (can be disabled)	"0" - no output fault "1" - output fault (LED on)
Maximum Field Cable Length	Defined by safety parameters
Output Set as Predetermined (OSP) timer	256, 512, 1024 ms
Output response time	1 ms turn on 2 ms turn off
Current consumption 24V external	250 mA
Current consumption 5V Modulebus	80 mA
Power dissipation	4.4 W
Voltage supervision	Internal process supply
Isolation	Each channel isolated from power, ground and each other
Mounting termination units	TU890
MTU keying code	AB
Safety classification	Class I according to IEC 536; (earth protected)
Protection rating	IP20 according to IEC 529, (IEC 144)
Rated insulation voltage	50V

Table A-10. DO890 Digital Output Module Specifications (Continued)

Feature	**DO890 Digital Output Module**
Dielectric test voltage	500V a.c.
Width	45 mm (1.77")
Depth	97 mm (3.8"), 106 mm (4.2") including connector
Height	119 mm (4.7")
Weight	0.2 kg (0.44 lbs.)

Intrinsic Safety Parameters

Table A-11. DO890 Analog Input Module Intrinsic Safety Parameters

Terminals	**Safety description**	**Maximum external parameters**				
		Groups CENELEC	**USA**	**C_0 (uF)**	**L_0 (mH)**	**L/R (uH/O)**
Powered output terminals	U_0 = 26 V	IIC	AB	0.099	4.1	58
	I_0 = 93 mA	IIB	CE	0.77	16.4	234
	P_0 = 605 mW	IIA	DFG	2.6	32.8	469

Output Characteristic

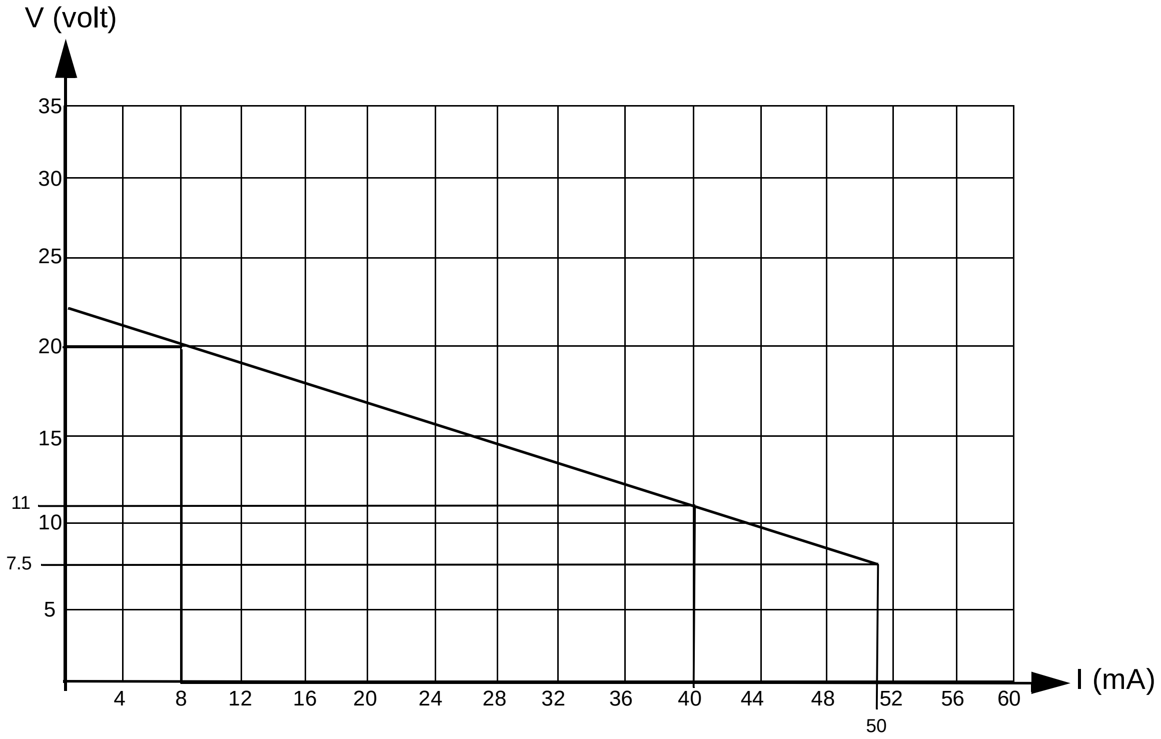
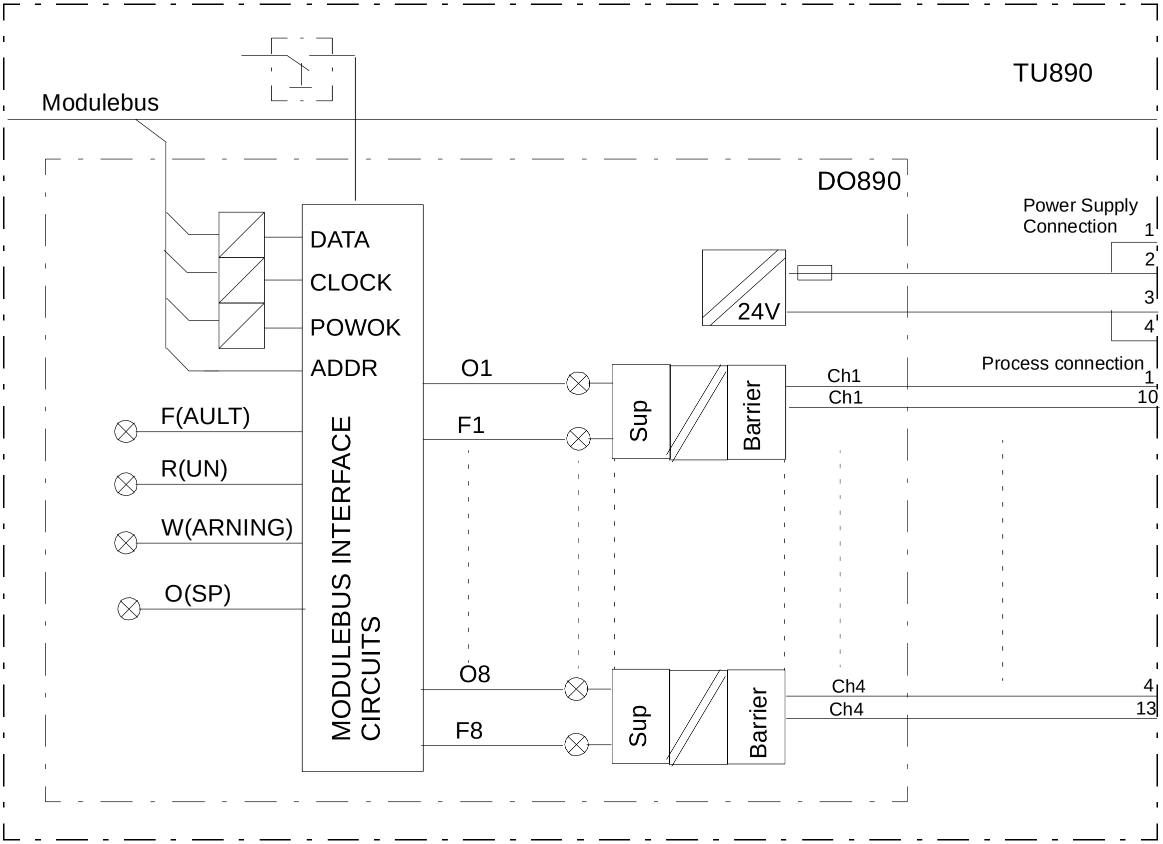


Figure A-1. Output characteristics for DO 890

Block Diagram DO890

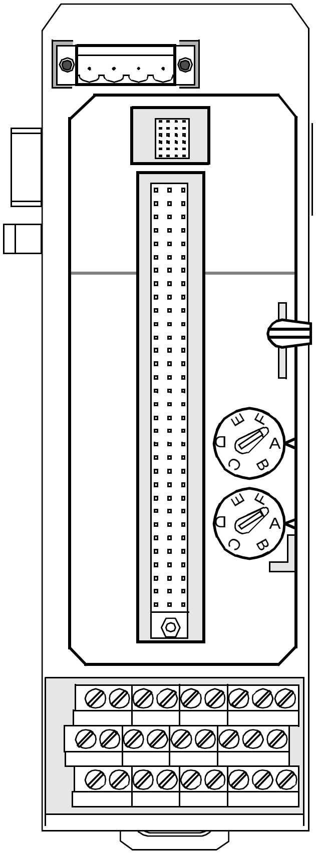


Process Connections

Table A-12. DO890 Process Connections

Process Connection	**TU890 Terminal**
Ch1 O/P. +ve	1
Ch1 O/P. -ve	10
-	-
Ch2 O/P. +ve	2
Ch2 O/P. -ve	11
-	-
Ch3 O/P. +ve	3
Ch3 O/P. -ve	12
-	-
Ch4 O/P. +ve	4
Ch4 O/P. -ve	13
-	-

A.5 TU890 Intrinsic Safety Compact MTU



Features

- Intrinsic safety applications - use with AI890, AO890, DI890, and DO890 modules
- Compact installation of I/O modules
- Field signals and process power connections
- Connections to ModuleBus and I/O modules
- Mechanical keying prevents insertion of the wrong I/O module
- Latching device to DIN rail for grounding
- DIN rail mounting.

Description

The TU890 is a compact module termination unit (MTU) for the S800 I/O. The MTU is a passive unit used for connection of the field wiring and power supply to the I/O modules. It also contains a part of the ModuleBus.

The TU890 MTU has terminals for field signals and process voltage connections. The maximum rated voltage is 50V and maximum rated current is 2A per channel, but these are primarily constrained to specific values by the design of the I/O modules for their certified application The MTU distributes the ModuleBus to the I/O module and to the next MTU. It also generates the correct address to the I/O module by shifting the outgoing position signals to the next MTU.

Two mechanical keys are used to configure the MTU for different types of I.S. I/O modules. This is only a mechanical configuration and it does not affect the functionality of the MTU or the I/O module. The keys used on the TU890 are of the opposite gender to those on any other type of MTU and will mate only with IS I/O modules. Each key has six positions, which gives a total number of 36 different configurations. The configuration can be changed with a screwdriver.

The MTU can be mounted on a standard DIN rail. It has a mechanical latch that locks the MTU to the DIN rail. The latch can be released with a screwdriver.

The MTU has a mechanical locking mechanism that locks the module in its position.
This mechanism also gives the signal BLOCK to the I/O module that keeps the module in its init state until it is locked in its position.

The top part of the MTU can be removed to replace the termination board even with an operational system. Such a need can be caused by a damaged terminal screw.

Technical Data

Table A-13. TU890 Compact MTU Specifications

Item	Value
Process Connections	27 blue terminals
Rated maximum continuous current per I/O channel	2A
PowerBus 24V current	1.5A
ModuleBus: Maximum 5V current distribution Maximum 24V current distribution	 1.5A 1.5A
Acceptable Wire Sizes	Solid: 0.2 - 4 mm^2 Stranded: 0.2 - 2.5 mm^2, 24 - 12 AWG Recommended torque 0.5 - 0.6 Nm
Mechanical Keys (2)	36 different combinations
I/O Module Lock	Locks module and enables operation
Safety classification	Class I according to IEC 536; (earth protected)
Protection rating	IP20 according to IEC 529, (IEC 144)
Rated insulation voltage	50V

Table A-13. TU890 Compact MTU Specifications

Item	Value
Dielectric test voltage	500V a.c.
Width	64 mm (1.77”) including connector, 58.5 mm (2.3”) edge to edge installed
Depth	58 mm (2.28”), 106 mm (4.2”) including terminals
Height	194 mm (7.6”) including latch
Weight	0.17 kg (0.37 lbs.)

Connections

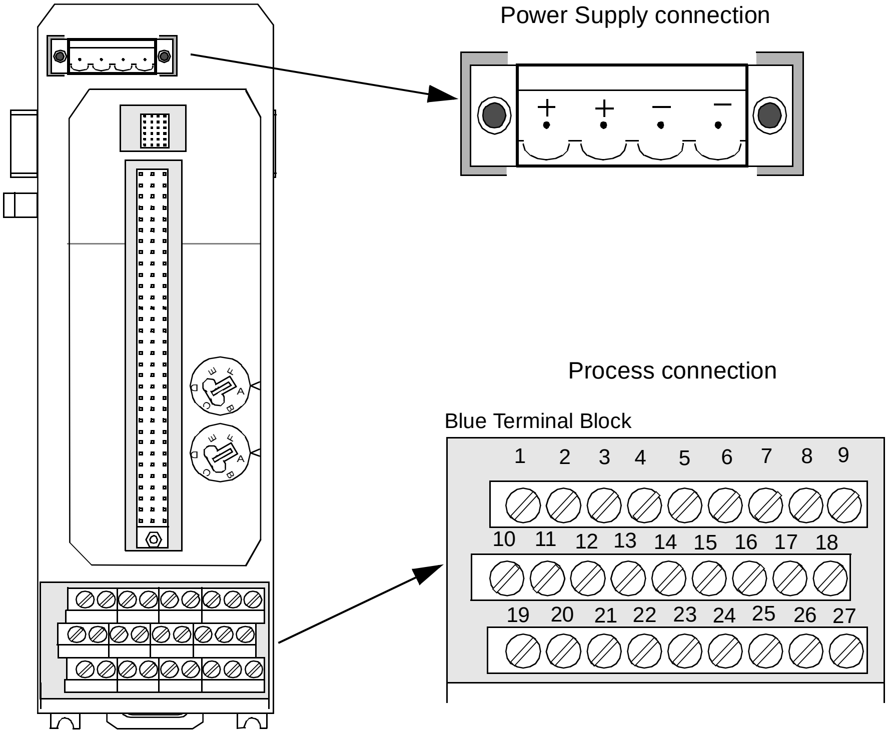
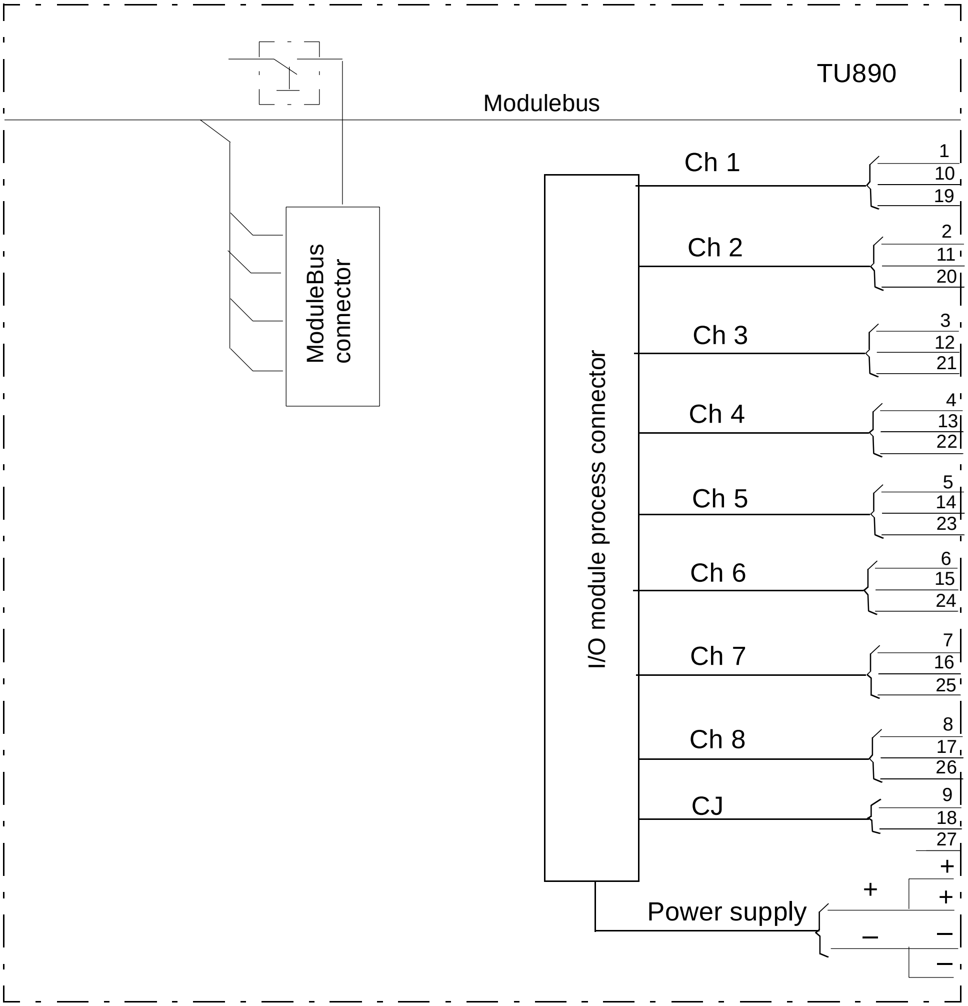


Figure A-2. Connections

Block Diagram TU890



INDEX

A
AI810 23, 25
Analog input module
  AI810 25
Analog output module
  AO810 31
AO810 23, 31

C
Compact MTU 5

D
DI810 23, 37
Digital input module
  DI810 37
Digital output module
  DO810 42
DO810 24, 42

E
Extended MTU 5

F
FCI 8
FCI and I/O module replacement 22

I
I/O modules 6
I/O station 9

L
LEDs
  I/O module 19

M
Module termination units 3
MTUs 24

P
Process connections
  AI810 30
  AO810 36
  DI810 41
  DO810 48

T
TU810 5, 24
TU811 24
TU830 24
TU831 5, 24
TU835 24